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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

CHEVROLET POWERGLIDE TRANSMISSION

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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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Chevrolet Powerglide Transmission

IN RETROSPECT of previous issues of this continuing series on American Automotive Hydraulic Transmissions[1] the astute reader may have observed that all of these transmissions were apparently applicable only to medium and high priced vehicles. Notwithstanding the multiple advantages of an automatic transmission, the long and expensive development work preceding each one, and the possible complexity and requisite nicety of its manufacture would logically combine to make it more expensive to build than its simple conventional forebears. As a consequence all automatic transmissions have been customarily introduced as extra price options, available only on the higher priced models, which would support those few who contend that "automatic transmissions are luxuries" and that they "can do a lot of gear shifting for a hundred and fifty dollars."

From the standpoint of utility, comfort, and safety, automatic transmissions *are* luxurious. But with thanks to our national ingenuity and productive power, the average American now enjoys thousands of "conveniences" that are justly regarded elsewhere in the world as true luxuries. For when the cost of a luxury is reduced without sacrifice of quality, then it becomes a "convenience" available to all.

(1) Lubrication, November 1946, Automotive Hydraulic Transmissions
Lubrication, April 1947, The Hydra-Matic Transmission
Lubrication, November 1947, The Hydrokinetic Torque Converter
Lubrication, November 1948, The White Hydro Torque Drive
Lubrication, November 1949, The Buick Dynaflow Transmission
Lubrication, October 1950, The Packard Ultramatic Drive

The next logical development in the rapidly growing field of automatic transmissions was therefore to evolve a design that when fixed in detail and subjected to large and expanding production would be most likely to give corresponding reductions in unit cost. Development costs on such a transmission could also be greatly reduced if it were possible to adopt the basic features of an existing design, particularly if the highly valuable background of manufacturing and service experience on that design were readily available and provided further that the design itself was fully amenable to high production methods. Since the punch press is synonymous with high production, the ideal design from the production standpoint should employ pressings and other automatically-produced parts to the maximum practicable extent. An automatic transmission which appears to meet all of these complex requirements was announced by Chevrolet Motor Division, General Motors Corporation and appropriately named the Powerglide. At date of writing more than 200,000 Powerglides are in use, more than 1,200 are being manufactured each day, and further substantial increases will be necessary to fully satisfy the public demand.

The Chevrolet Powerglide is the first automatic transmission (and the first torque converter) to appear in the lowest-priced car field. As in other large undertakings in the past, Chevrolet benefited through the knowledge and resources of General Motors in the development of the torque converter transmission. Corporation experience with torque converters goes back more than thirteen years, to

the development of automatic hydraulic drives for buses. After more than four years of intensive design and test work, Chevrolet's version of the hydraulic torque converter transmission was ready for the motoring public. Although it is similar in many respects to the Buick Dynaflow, the Chevrolet Powerglide transmission incorporates many important innovations.

The Powerglide is optional equipment on the DeLuxe Chevrolet but the name is strictly applicable to an optional "automatic drive package" consisting of (1) the automatic transmission itself (2) a new larger overhead valve 105 horsepower engine equipped with hydraulic valve lifters and (3) a 3.55 ratio rear axle, which reduces engine revolutions per mile nearly 10% below the conventional car. The conventionally-transmissioned Chevrolet continues to employ a 92 horsepower engine and 4.11 ratio rear axle. The power and torque characteristics of the new engine are exceptionally well suited to the converter's requirements: together with the lower rear axle ratio, the components of the Powerglide automatic drive package form a well integrated team which successfully combines smooth and brilliant performance with good economy.

DRIVER'S CONTROLS AND OPERATION

The Powerglide is so fully automatic that the driver requires only two simple control devices,— the normal foot throttle or accelerator, and occasionally a finger tip Selector Lever. There is no clutch pedal for none is required. Since only the normal brake and accelerator pedals remain on the floor boards, some drivers find it convenient to retrain themselves to habitually use their otherwise unoccupied *left* foot to apply the foot brakes: the resultant "two foot driving" is particularly convenient in heavy traffic where many stops and starts have to be made.

As its name indicates the function of the Selector Lever is to permit the driver to *select* any of the five lever positions which in turn determine the direction and speed range of car movement. An associated pointer and dial indicates the five Selector Lever positions from left to right as follows: "Park", "N" (i.e. Neutral), "D" (i.e. Drive), "L" (i.e. Low) and "R" (Reverse). Incidentally these positions are in the same order as that generally used in other automatic transmissions presently marketed, a feature of considerable convenience to drivers who must operate several different cars. To prevent unintentional movement, the selector lever mechanism is "gated" so that the lever must be pulled towards the driver before it can be moved into either the Park or R positions, or out of Park position. A special "neutral switch" on the extreme lower end of the selector lever shaft is electrically connected between the starter button and starter solenoid so as to prevent use of the starter in any but the "Park" and "N" positions of the selector lever.

As will be explained later the control lever is mechanically linked to the Manual Valve in the transmission, and the position of the manual valve directly controls the functioning of the transmission. To obviate the effects of misadjustment or the inevitable development of back lash in linkage, Chevrolet has located the detents (which positively position the manual valve — within the transmission itself, so that no adjustment is ever required.

When placed in the Park position, the selector lever pushes a stationary pawl into the teeth of a gear connected to the propeller shaft and the car's rear wheels are rigidly and immovably locked. This feature is of considerable comfort when the car must be parked on a steep grade. Furthermore the fact that the engine can be started on a steep grade without back-rolling and then smoothly connected to the wheels by a simple flick of the finger is a safety feature that is appreciated by all.

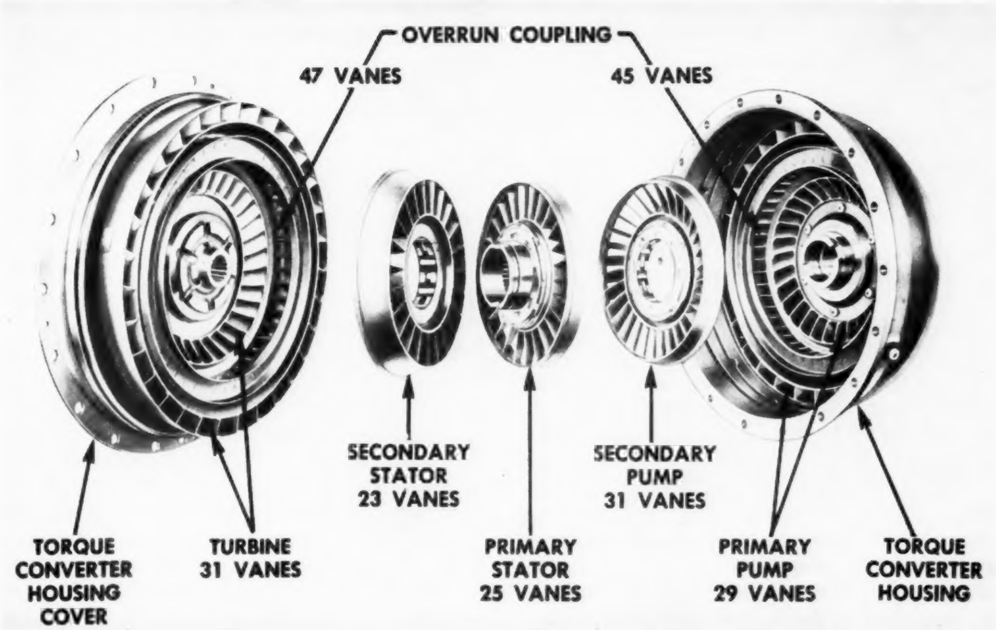
The "N" (Neutral) position is functionally similar to the "Park" except that the parking pawl is *not* engaged, the rear wheels are therefore free to rotate, and the car can roll.

The "D" (Drive) position is practically universal in its ability: consequently it is used by most drivers for at least 98% of all forward-direction starting, acceleration and driving. For example when the selector of a Powerglide-equipped car is moved to "D" position with the engine idling, the car remains stationary until additional pressure on the accelerator causes it to accelerate rapidly and smoothly to the desired driving speed without any "shifts", jerks, hesitations, throttle releases or other interruptions and distractions. Excessive engine noise that is commonly associated with torque converters has been reduced to an unnoticeable level. The use of a more powerful engine permits a lower rear axle ratio. Because of the all-hydraulic drive, vibrations that originate in either the power plant or the road are largely isolated and blanketed. Normal road grades are negotiated so easily and naturally that they pass unnoticed. Additional acceleration to pass a car is instantly available by merely pressing the accelerator.

By virtue of the overrun coupling (to be discussed more fully later), the Powerglide immediately and noticeably decelerates as soon as the accelerator is released with no sensation of "free wheeling".

For those interested, the top speed of the Powerglide-equipped Chevrolet is about seven miles higher than its conventionally transmissioned counterpart.

The "L" (Low) position of the selector lever



Courtesy of Chevrolet Motor Division, GMC

Figure 1 — Powerglide Converter-Coupling Elements.

provides an extra-powerful "low gear" for the negotiation of long, very steep grades, deep mud or sand and heavy snow. For those who like to leave the other drivers far behind at stop lights, the "L" position provides the ultimate in get-away: as soon as the car has attained any speed up to about 40 miles per hour, a "shift" to the normal "D" position is made by a mere finger flip and without necessarily letting up on the throttle. Conversely the "L" position provides additional engine braking power for the descent of dangerous grades.

The use of the "R" (Reverse) position for backing is obvious: unlike the conventional transmission however, a Powerglide-equipped car may be "rocked" out of sand or snow by just pulling the selector lever towards the driver and then moving it back and fourth between the "L" and "R" positions with the engine running steadily at a moderate speed. With a little practice, anyone can learn to synchronize selector lever movements with the "rocking" motion set up by the continuous reversal of the car's direction.

If a "dead" battery prevents use of the starter, the Powerglide's engine is readily started by (1) placing the selector in "N" position, (2) pushing the car up to a speed of 15 mph with another car (or allowing the car to coast down a grade) and (3) moving the selector lever to the "L" position. As soon as the engine has started, the selector lever should be moved back to "N" position for warmup. If traction is poor due to wet or icy roads, possible skidding is minimized by pushing (or coasting) the car in "N" Position to twenty miles per hour, and then moving the selector lever into the "D" position. In any case be sure that the car is *pushed:* should it be *pulled* instead, it may accelerate right into the tow car when the engine starts.

Now let us examine the hidden mechanisms that are responsible for the performance of this transmission. As hinted in the foregoing and as illustrated in Figure 3, the Powerglide consists of three general groups: a torque converter, a gear box, and hydraulic controls, which are described in detail as follows.

CONVERTER-COUPLING GROUP

The heart of the Powerglide Transmission is the converter-coupling, which is basically the five-element polyphase type described in detail in a preceding article[2] but with several important innovations. A cross-section of the five elements is illustrated in the lefthand portion of Figure 3, an "exploded" view of the separate elements is shown in Figure 1. The reader is reminded that these five elements constitute a complete automatic transmission within themselves. When starting movement of the car and without any external guidance or driver attention they operate as an infinitely smooth automatic clutch *plus* an infinitely variable torque multiplier. During acceleration they first multiply

(2) Lubrication, November 1949, The Buick Dynaflow Transmission

engine torque by as much as 2.2 times and then gradually and automatically reduce this torque multiplication ratio through an infinite series of "stepless steps" to a value of nearly 1:1 at cruising speeds. If it were not for the occasional requirement of moving the car backwards, or of idling the engine for extended periods, or of climbing an exceedingly steep trail, the auxiliary gear box and its controls would be unnecessary.

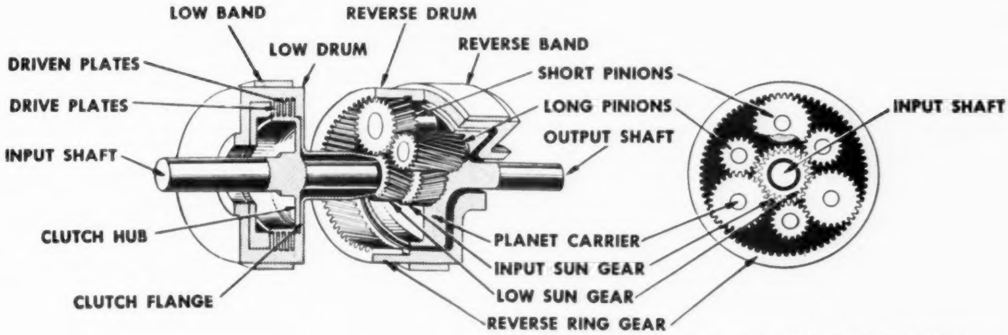
The engine is always directly connected to and driving the torque converter housing with its contained primary pump (Refer again to Figures 3 and 1). Under "stall" condition (i.e. selector lever in D, L, or R position; engine running at wide open throttle; car held stationary) both the primary and secondary stators are stationary since their overrunning clutches lock them to the always-stationary stator support. They are therefore exerting their maximum reaction and maximum torque-multiplying effect. At the same time the secondary pump, being driven by fluid impingement on the backs of its blades, is rotating more rapidly or "overrunning" the primary pump, and is thus able to reduce shock loss in the fluid entering the primary pump. If the turbine is still held stationary, it now exerts a static torque on the input shaft of the transmission equal to 2.2 times the engine's torque at the converter stall speed (approximately 1575 RPM).

If the car is allowed to move, it accelerates rapidly as the turbine speed increases and the necessity for torque multiplication decreases. The speed of the secondary pump also decreases until it finally equals that of the primary pump and locks to it by means of the interposed over-running clutch. Also as turbine speed increases, first the secondary stator and lastly the primary stator unlocks and begins to rotate more or less synchronously with the other elements. As soon as the primary stator unlocks, the converter becomes a fluid coupling which transmits engine torque to the rear axle at a ratio that is practically 1:1. Under normal steady level road driving this occurs at about 25 mph. Under full throttle acceleration the primary stator unlocks at a car speed of about 50 mph, which is another way of saying that the converter can generate superior hill climbing ability or acceleration up to about that speed, and that thenceforth the engine is "on its own" very much as it would be throughout the entire high gear speed range of a conventional transmission.

Unlike its distinguished predecessors, the Powerglide is the first torque converter to employ pressed-steel blading in all elements. After only a glance at Figure 1, and at the complexity and precision of the five elements, the reader will sense the magnitude of this accomplishment. Actually the accomplishment of this "first" taxed the combined ingenuity and pioneering ability of a large group of the best stamping and production men in this country for a period of several months. Each of the 139 vanes in the torque converter and the 92 vanes in the overrun coupling are accurately stamped from sheet steel of special quality, simultaneously curved to their finished form, assembled into their elements using special locating jigs, and spot-welded in some instances. All joints in the temporary assemblies (including those previously spot-welded) are then copper-brazed in hydrogen-atmosphere furnaces. After cooling, the assemblies are re-struck in special "assembly" dies to correct any heat distortion, and any excess copper or steel is then machined off to complete the assembly.

To secure maximum strength in any copper-brazed joint, it is first necessary to secure a tight accurate fit between the parts that are to be joined, and then to apply just the right amount of metallic copper. From the wastage standpoint as well as several others it is particularly desirable to avoid splashing an excess of copper over adjoining parts. High accuracy of preliminary fitment of the vanes in the Powerglide assemblies was accomplished by inspired die work. The next problem of regulating the amount of copper used was very ingeniously solved by dispersing fine copper powder throughout a carrier fluid of controlled viscosity. When the preliminary assemblies are dipped in this solution, the fluid penetrates and is retained in the proposed joints carrying the desired amount of copper with it. The assemblies are then drained in such a position that any small drops of excess fluid will collect on a surface that is to be machined during the finishing process, and the assemblies are charged to the brazing furnace.

The second important innovation in the Powerglide converter is its pioneer usage of an Overrun Coupling to facilitate engine braking and starting of the engine by pushing the car. The two vaned rings which compose this special auxiliary fluid coupling are readily visible in Figure 1 and are contained within the torus rings of the turbine and primary pump in space that would be otherwise occupied by inactive fluid. Terminology is likely to be confusing in this instance since that portion of the overrun coupling that is within the converter *turbine* actually acts as a *pump* during deceleration and will be so called: similarly the overrun coupling blading within the converter's pump actually receives oil and serves as a *turbine*. It will be noted that the radius of rotation of the blading in the "left side" or pump blading of the overrun coupling is somewhat larger than that in the opposing ring. Furthermore the pump blades are curved in such direction as to "hook into" the oil supply at their inner diameter and to throw it outward violently before delivering it to the opposite blading. This sets up a vortex flow in the oil, transmitting substantial torque to the engine. As a consequence, the



Courtesy of Chevrolet Motor Division, GMC

Figure 2 — Powerglide Compound Planetary Gear.

overrun coupling is quite effective whenever the car tends to drive the engine: but has negligible effect during normal operation.

THE GEAR BOX

As previously explained the gear box is only an auxiliary to the practically universal converter-coupling but is unfortunately necessary to provide reverse and extra-low gear operation as well as neutral.

A review of Figure 3 will show that the necessary presence of such a gear box with its attendant hydraulic controls more than doubles the apparent complexity of the whole transmission. From examination of Figure 2 it will be seen that the Powerglide gear box is a very compact hydraulically controlled and actuated planetary.

Since the converter-coupling performs all necessary functions during normal driving, the planetary is manually controlled by the driver, but is hydraulically actuated as a convenience in response to his direction. It will be noted from Figure 2 that the functioning of the planetary is quite conventional inasmuch as it is controlled by a hydraulically-applied multi-disk clutch and two hydraulically-contracted brake bands, the entire assembly being exceedingly compact.

The four driving plates of the clutch are faced on both sides with a molded metallic friction material and are splined to their hub which in turn is splined to the transmission input shaft. The five steel driven plates are slightly dished to assist separation and are similarly splined to the interior of the low drum which is splined to the low sun gear. The plates are engaged by means of oil pressure on an annular piston, and are disengaged by spring pressure when oil pressure is removed. As will be seen later, the actuating oil is not only "modulated" (its pressure adjusted to the torque demands on the clutch) but is applied through a small restricting orifice which effectively cushions the clutch and causes it to engage quietly, smoothly, and unobtrusively. A malleable iron friction-faced and hydraulically actuated brake band on the exterior of the low drum is used to permit it to turn or to lock it stationary as desired. To insure that centrifugal action does not generate an unwanted oil pressure behind the clutch piston when it is required to be disengaged, the manufacturer has installed an oil bleeder valve which is held closed by spring pressure but opened mechanically by the piston in its disengaged position so that oil seeping into the piston chamber is discharged to the sump.

The three long and three short pinions meshing as shown in Figure 2 are mounted on needle-bear-ringed spindles carried by the pressed steel planet carrier which in turn is riveted to an integral flange on the transmission output shaft. As an interesting bit of design it should also be noted (in Figure 3) that the parking gear is fixed to the front end of the planet carrier.

The reverse drum with its internal gear is mounted on a plain bearing in the transmission case and is free to turn unless locked stationary by its hydraulically actuated malleable iron brake band.

Following for the convenience of those readers who have not had access to previous articles are brief descriptions of the five operating conditions of the compound planetary, direction of rotation being described as if viewed from the front of the car with engine running.

"N" (Neutral). Clutch and both bands are released, the converter turbine is driving the input sun gear clockwise, which drives the long pinions counterclockwise and the short pinions clockwise around their own axes. Since neither the low sun gear nor the reverse drum are restrained, there is no reaction to the short pinions which rotate idly and "windmill" the low sun gear counterclockwise and the reverse internal gear clockwise, both without effecting any transfer of torque to the planet carrier and output shaft.

"Park". The planetary gear itself is in neutral position: in addition however a stationary pawl is manually forced into engagement with the teeth of the parking gear on the front of the planet carrier,

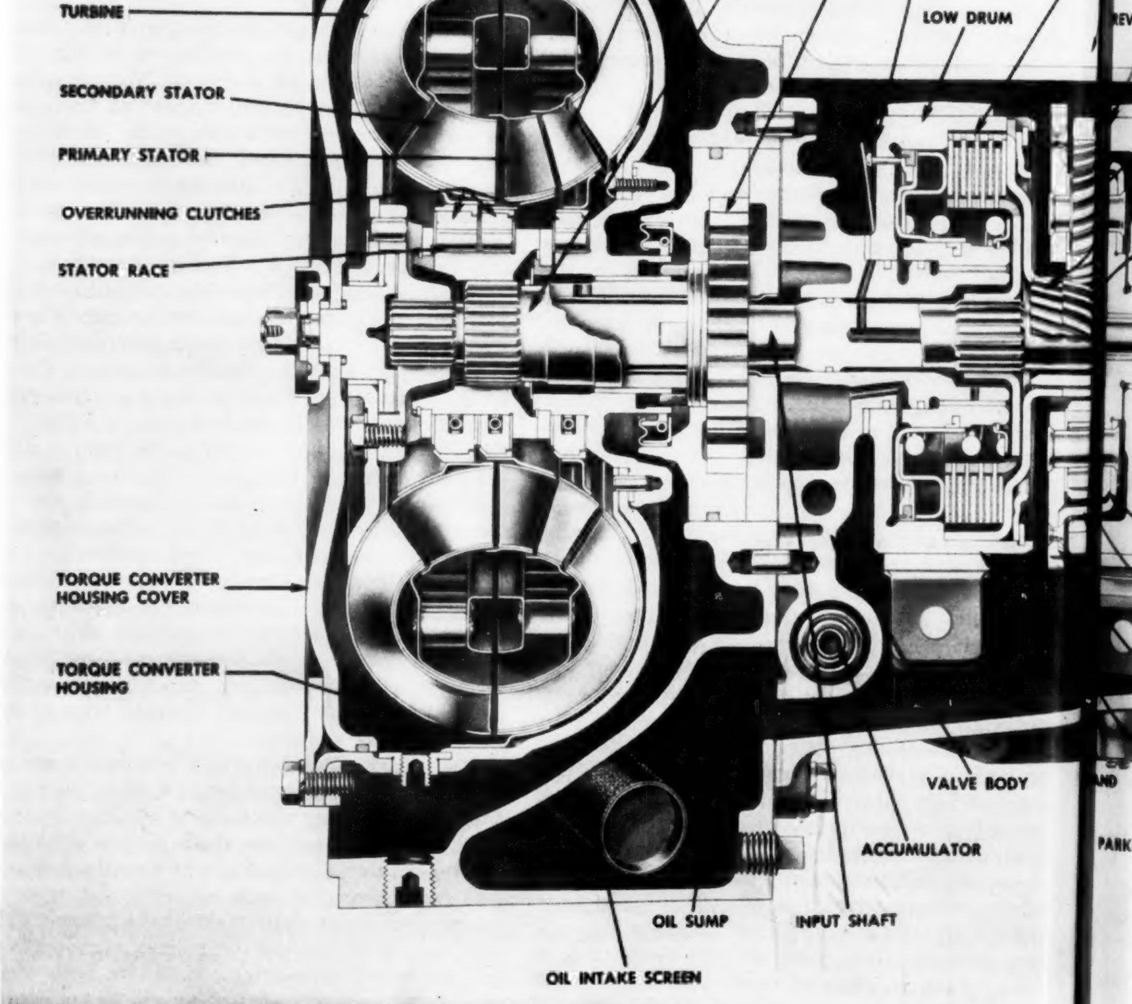
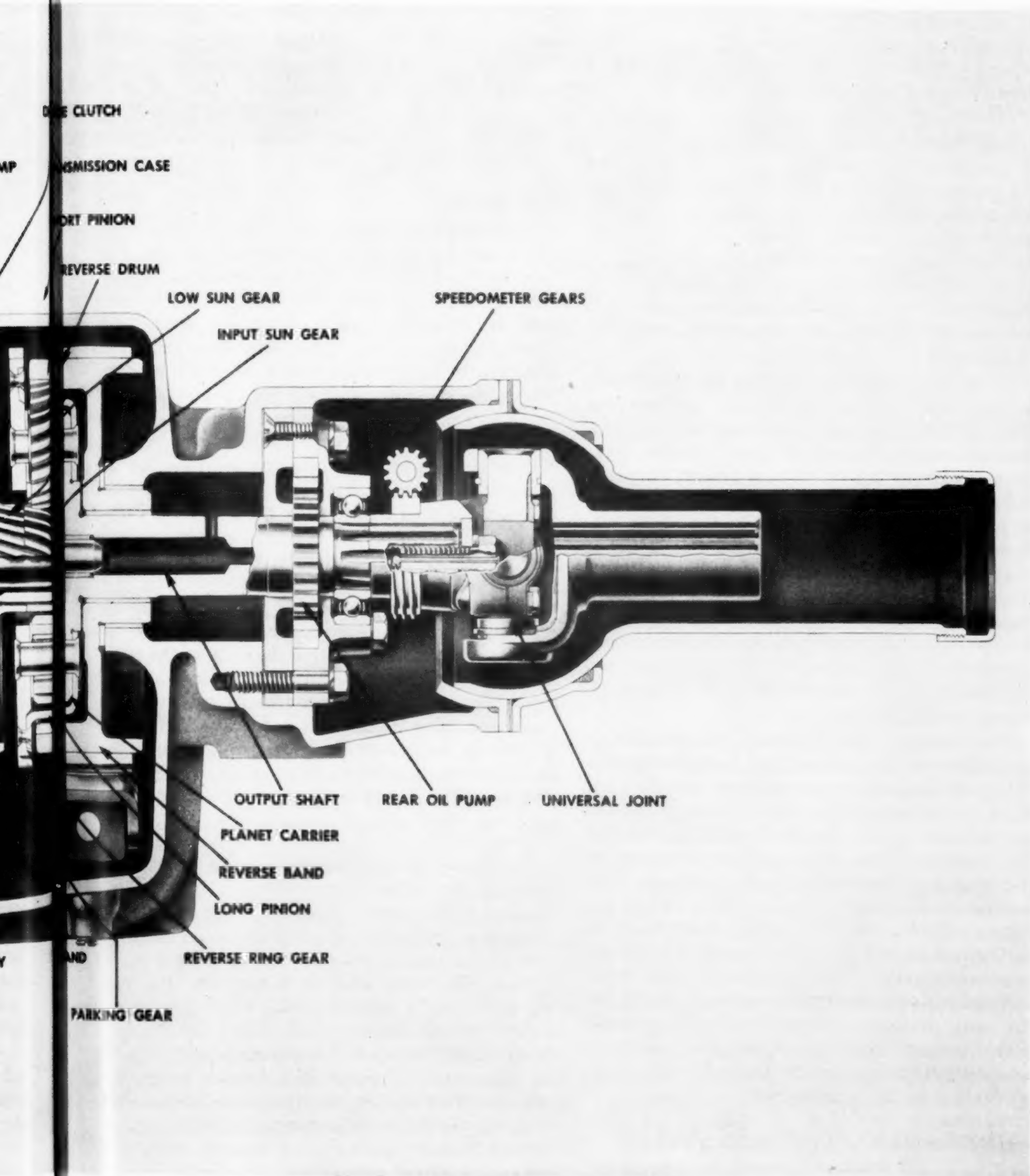


Figure 3 — Cross-section, Chevrolet Powerglide



on, Che glide Automatic Transmission.

Courtesy of Chevrolet Motor Division, GMC

rigidly locking it and the transmission output shaft in a fixed stationary position to the transmission and car chassis. Because the pawl is spring-actuated, and because of its tooth design, it cannot be engaged nor will it remain engaged with the parking gear if the car is moving. Any attempt to engage it improperly will therefore result in nothing worse than a horrifying but harmless warning rattle.

"D" (Drive). Clutch is engaged with both bands released. Since both sun gears are now locked to the transmission input shaft, both the short and long pinions are unable to turn around their own axes: consequently the entire planetary assembly is "locked up" and rotates as a unit and at the same speed with the transmission input and output shafts. Torque multiplication ratio of the planetary alone is therefore 1 to 1: with the converter under stall condition the maximum torque multiplication ratio is 2.2 times 1 or 2.2.

"L" (Low). Clutch and reverse bands released, low band is applied and holding the low sun gear stationary. The input sun gear drives the long pinions counterclockwise and the short pinions clockwise around their individual axes, forcing the short pinions to travel clockwise around the stationary low sun gear and therefore driving the planet carrier and transmission output shaft clockwise but at reduced speed. The torque multiplication ratio of the planetary is 1.82: when combined with the converter under stall condition the total torque multiplication ratio is 2.2 times 1.82 or 4.00. Incidentally under these conditions the internal reverse gear and drum also move idly in a clockwise direction without contributing to the drive.

"R" (Reverse). The clutch and low band are released, however the reverse band is applied and is holding the internal reverse ring gear stationary. As before, the input sun gear drives the long pinions counterclockwise and the short pinions clockwise about their own axes. Because of the stationary reverse ring gear however, the short pinions must "walk around" it and take the planet carrier and output shaft with them in a reverse (counter-clockwise) direction and at a lower speed. The torque multiplication ratio of the planetary is 1.82: when combined with the converter's stall ratio of 2.2, the total ratio in reverse becomes 4.00. Incidentally under these conditions the low sun gear and clutch drive plates rotate idly in a clockwise direction without affecting the drive in any way.

HYDRAULIC CONTROL SYSTEM

As previously inferred the hydraulic control system is merely a powerful servant which faithfully receives and implicitly obeys instructions from the driver. To carry out these instructions the control system utilizes oil under controlled pressures and applies these pressures in proper order to the appropriate hydraulic mechanisms within the transmission. Since the Powerglide does not — and does not have to — "shift" gears, its control system does not need any complex sense of timing. The hydraulic system as a whole contains several ingenious innovations and is characterized by a cleanness of design and by the resultant avoidance of extraneous "plumbing". During the following brief descriptions of the principal elements of the Powerglide Hydraulic System, the reader will require frequent reference to Figures 4 and 5.

Oil Pumps

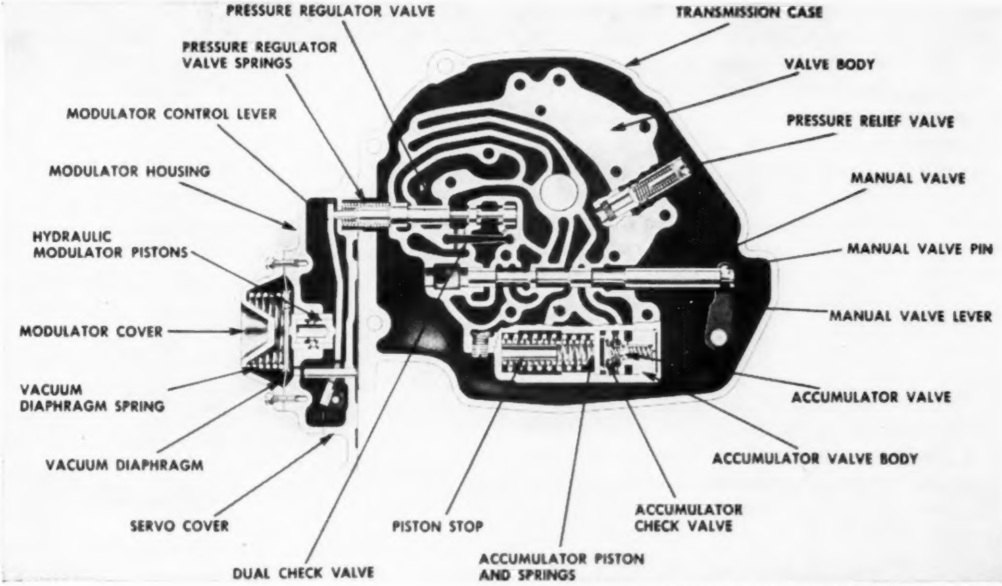
The Powerglide is provided with two oil pumps, the Front and Rear, of the internal-external gear type having a common screened intake at the bottom of the transmission sump and both discharging into the hydraulic system through a dual check valve. As illustrated in Figure 3 the Front Oil Pump which is the larger of the two, is located just to the rear of the converter and is driven at engine speed by an extension of the converter pump shaft. The smaller Rear Oil Pump is positioned at the extreme rear of the transmission case and is driven by the transmission output shaft and hence by the car's rear wheels. As a consequence the Front Oil Pump is effective whenever the engine is running regardless of car movement or direction of movement, and up to car speeds of about 15 mph. The Rear pump is provided to furnish oil pressure to the transmission when starting a "dead" engine by pushing the car and furnishes the bulk of the transmission's requirements at driving speeds above 15 mph. Thus the two pumps together form a working team, operating together or independently according to the actions of the pressure regulator valve and dual check valve so as to avoid power losses that would otherwise occur through idle pumping.

Valve Body

The valve body, illustrated in Figure 4, is the heart of the hydraulic system, since it contains a number of important valves which control the development, modification, distribution and coordination of the various oil pressures generated by the pumps. The valve body is a complex iron casting containing a maze of passages and ports and is located just to the rear of the Front Oil Pump so as to simplify the oil distribution system, shorten oil passages, and reduce fluid friction losses. The several valves which it contains are of hardened steel, the working combination of cast iron and steel having been chosen to avoid thermal differential expansion effects and to eliminate valve sticking caused either by casting growth or dirt embedment.

Manual Valve

This valve of the stepped piston type located within the valve body is linked to the driver's



Courtesy of Chevrolet Motor Division, GMC

Figure 4 — Powerglide Valve Body.

selector lever, and therefore translates the driver's selection to the hydraulic system.

Dual Check Valve

The dual check valve, visible in both Figures 4 and 5, is uniquely shaped like a heavy, wide hair pin and is located in the valve body at the junction of the discharge lines of the two oil pumps. Its function is to coordinate the output of the pumps.

Pressure Regulator Valve

As its name implies, the function of this important valve in the valve body is to control oil pump discharge pressures and to vary these pressures for certain transmission operations in response to hydraulic signals from other associated valves, such as the modulator valve. The regulator valve also maintains the pressure of oil fed to the torque converter, and keeps the latter full when the car is operating.

Modulator Valve

As illustrated in Figure 4, the modulator valve is a highly ingenious device, which combines the dictates of the driver as expressed through his foot throttle and selector lever, and translates the summation of these two orders into a signal to the regulator valve, causing it to generate and control that definite hydraulic pressure which will be most satisfactory for the transmission under the operating condition imposed by the driver. In short the modulator is a go-between. Under the relatively easy transmission condition of normal level-road driving, the modulator chooses a relatively low transmission oil pressure with resultant high transmission efficiency: when the driver selects a severe operation such as climbing an extremely steep grade in Low or Reverse range, the modulator causes the regulator to generate and control the requisite much-higher transmission oil pressure.

To accomplish its ambassadorial functions, the modulator combines two sensing devices, the vacuum diaphragm and the hydraulic modulator pistons. The vacuum diaphragm is connected to the engine intake manifold vacuum, thus obtaining a measure of the load imposed upon the engine. Under normal part-throttle level-road driving, engine manifold vacuum is so high that the modulator vacuum diaphragm is sucked outward against its spring and exerts little or no pressure on the regulator valve: contrariwise however when the engine throttle is opened wide (such as to accelerate or climb a grade), engine manifold vacuum drops and, under the impetus of its spring, the vacuum diaphragm moves toward and exerts pressure on the regulator valve, causing it to generate a higher oil pressure. In short the vacuum diaphragm is used principally in the Drive range where it keeps oil pressure (and pumping losses) as low as consistent with engine load.

One of the hydraulic modulator pistons telescopes within the other so that the pair will expand when oil pressure is applied to their interiors. The function of these pistons is to insure the generation of the requisite high oil pressure to clamp and hold the appropriate planetary band whenever the driver places the transmission selector lever in its Low or

Reverse position. Under these conditions the two pistons expand, over-ruling the vacuum diaphragm by forcing it back against its stop on the one hand, and exerting considerable pressure in the opposite direction on the modulator control lever and pressure regulator valve, causing the latter to generate the desired high oil pressure. Conversely under normal driving range, oil is not admitted into the hydraulic modulator pistons, consequently they contract against each other and constitute only a solid inactive link which merely transmits force between the now-effective vacuum diaphragm and the pressure regulator valve.

Accumulator

The accumulator is a spring-loaded piston with two valves located in the lower part of the valve body and interposed hydraulically between the manual valve and hydraulic modulator. The accumulator is effective only in Low and Reverse. It contains a valve that will not open until an oil pressure of 55 psi is attained, and acts under those conditions to admit oil to the modulator. The spring-loaded accumulator piston acts as a surge chamber in retarding a sudden rise in oil pressure when the driver moves his selector lever from Drive to Low.

Pressure Relief Valve

This spring-loaded valve is normally inactive, and is placed in the valve body and on the common discharge line of the two oil pumps to insure that an oil pressure of 200 psi will never be exceeded. In the rare instances when it opens, the valve relieves excess pressure by discharging directly to the sump.

Converter Oil Supply

When either the engine is running or the car is moving, oil under pressure is pumped into and through the converter to keep it completely full. Orifices in the converter intake and in the discharge lines are used to reduce main line oil pressures from the regulating valve to some lesser but proportional pressure suitable for the converter. Whenever the engine is stopped, the pressure regulator valve closes the converter feed line.

Thermostatic Bypass Valve

Oil leaving the converter has been warmed up to a degree proportional to the work that it has performed, and is thereafter routed to the thermostatic bypass valve located in the servo cover adjacent to the modulator. As indicated in Figure 5, the thermostatic bypass valve consists of a normally-open spring-loaded ball check valve which is held off its seat by a bi-metallic strip thermostat. Whenever oil temperature exceeds 240° F., the bi-metallic strip deflects away from the by-pass valve and allows it to close thus forcing the oil to flow outside the transmission to the oil cooler: as long as oil temperature remains below 240° F. (and this is the case in all normal driving) the bypass valve remains open and oil flows directly within the transmission from the converter into the transmission's lubrication system.

Oil Cooler

A transmission oil cooler of the oil-to-water type is inserted between the lower radiator connection and water pump of the engine's cooling system. Warm oil from the transmission enters the cooler at its top, flows down a baffled core, and is returned to the transmission's lubricating system. As further provision against improbable overheating, the radiators on Powerglide-equipped Chevrolets are constructed with approximately 8% more radiating surface than the standard, and in addition are fitted with pressure caps set to about 4 psi.

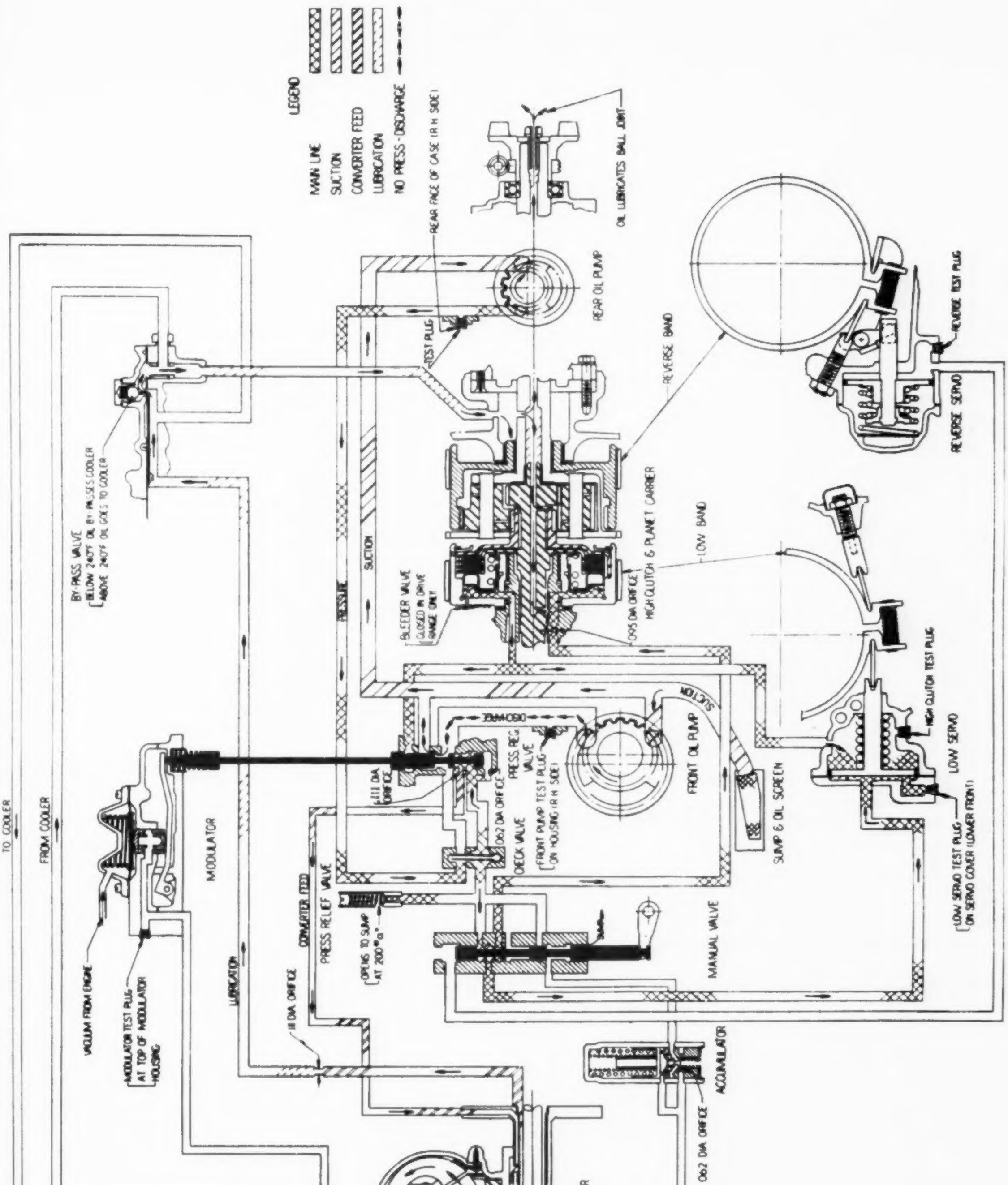
Low Servo

It will be recalled that the two servos and the multi-disc clutch are the agents used to control the planetary by changing hydraulic pressures to mechanical forces and that the clutch has been previously described.

As diagrammed in Figure 5, the Low Servo consists of a spring-loaded piston and cylinder so arranged that the application of sufficient oil pressure to the left side of its piston will contract the low band. From the hydraulic diagram (Figure 5) it will be noted that when the Low Servo is in its released (lefthand) position, both sides of its piston are subjected to equal oil pressures. The Low Servo is applied by gradually (through accumulator action) increasing the oil pressure on its lefthand side to a maximum of 180 psi and by simultaneously discharging the oil from the right side. Since oil from the right side is discharged through the restrictor in the Drive range clutch, the latter not only assists the accumulator in providing a smooth application of the Low Servo, but effectively prevents complete release of the clutch until the Low band is fully applied.

Reverse Servo

It will be noted from Figure 5 that the reverse servo differs in several respects from its companion. For example it utilizes a compound lever system to contract and hold the low band with considerable force. Unlike the low servo however oil pressure is built up *only* on the *right* side of the piston. During application the spring-loaded piston first moves as a unit to take up any slack in the linkage. Then, as the band begins to tighten, the inner spring is compressed and the piston moves along its rod for 1/8" before solidly contacting a shoulder and forcing the rod to continue its movement and to complete application of the band. This "cushion" feature



Courtesy of Chevrolet Motor Division, GMC

Figure 5 – Hydraulic Diagram (Drive Range).

acts to soften the initial application of the band. The two springs illustrated are necessary (1) to return the piston along its rod to its right-hand position and (2) to insure that both the piston and its rod move fully to their released position, exhausting oil from the chamber.

LUBRICATION AND CARE

All moving parts of the Powerglide and even the adjacent universal joint either operate in a bath of oil or are pressure-lubricated by temperature-regulated oil from the thermostatic bypass valve. The entire system requires ten quarts to fill it to the full mark on its dipstick. Refill capacity however is nine quarts. Chevrolet recommends that the oil be checked each 1000 miles and replenished if necessary, and that it be drained and replaced regularly every 25,000 miles. From the preceding description of the Powerglide, the reader will correctly deduce that the oil contained in it is a very important part of the assembly. The oil not only has its own several functions to perform, but it must also assist and protect all of the associated mechanical parts. Since each separate function requires certain specific properties, the task of successfully combining all of these properties in a single oil has been difficult. Basically the oil is a high quality mineral type, but since no simple straight mineral oil is capable in itself of meeting all of the diverse requirements, the base oil must be reinforced with a considerable number of specialized chemicals, and the resultant blend is one of the most complex materials in general use. Keeping in mind that the primary requirement of the oil is that it do its job perfectly in the Powerglide during 25,000 miles of widely-variable operating conditions, the reader will realize that while the following properties are important and indicative of the general nature of the oil, they are at best only superficial surface indications of the real and necessary but hidden quality beneath.

High Oxidation Resistance

As the oil in the Powerglide is circulated through the converter and planetary gearing, it is heated and intimately mixed with atmospheric oxygen, all of which would quickly oxidize an ordinary oil. However even a relatively small amount of oxidation might cause the formation of oil sludge or varnish, and either of these undesirables could seriously hamper or prevent proper operation of the Powerglide. It is therefore paramount that the oil not only possess a high degree of oxidation resistance, but that it be regularly replaced every 25,000 miles with oil of comparable quality.

Viscosity, Viscosity Index and Pour

The combined requirements of the converter coupling, the hydraulic system, pumps, valves, bearings and gears all dictate that the oil have a minimum viscosity of about 50 SU seconds at 210° F. Since the same oil will be used during both summer and winter, its viscosity should vary as little as possible with change in temperature, which is to say that it should possess a high viscosity index. Furthermore and unless the transmission oil pumps can suck and pump the oil, the Powerglide cannot function, consequently the oil should also be able to pour (or have a "pour point") down to about minus 35° F., the lowest winter temperature ordinarily encountered in this country.

Oiliness

The smooth engagements of the multi-disk drive clutch, the low range band, and the reverse band are all assisted by the presence of a fair degree of "oiliness" in the oil, and this peculiar property is not found in ordinary oils. Furthermore the oiliness property is valuable during the initial operation of a new transmission since it assists in "running in" the various parts.

Foam Resistance

As in most hydraulic systems the presence of any appreciable air-oil foam can not be tolerated in the Powerglide since it interferes with proper operation of the hydraulic system, decreases or even destroys torque multiplication and transmission, causes violent overflow and loss of oil, and promotes oxidation. A high degree of resistance to foaming is therefore an essential quality.

Chemical Activity

The oil must not adversely affect any of the metals, gasket materials, clutch facings or band liners used in the Powerglide, nor must it be affected in itself through a long contact with these materials.

Availability

Fortunately for everyone concerned, a number of oils which meet the above severe requirements are now readily available for retail purchase through most automobile manufacturer and oil company service agencies, the only problem being the sure identification of these oils. The problem of identification has been greatly simplified in recent months: regardless of the remainder of the manufacturer's trade name, the words "Automatic Transmission Fluid — Type "A" will always be included as part of the trade name, and the container will be stencilled or embossed with the letters "AQ-ATF" followed by a specification qualification number. The use of an oil so marked with faithful adherence to Chevrolet's installation and draining procedures should insure trouble-free transmission fluid performance and will assist the Powerglide in continuing to deliver the full measure of its brilliant performance.

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